It appears that the relation $v = \sqrt{h}$ and also the formula of Hellmann, $v/v_1 = \sqrt[5]{h/h_1}$ yield similar results. We can write this last equation as

$$\frac{\log v - \log v_1}{\log h - \log h_1} = c$$

which can be rewritten as

$$\log v - c \log h = \log v_1 - c \log h_1 = C.$$

If $C$ approaches zero we obtain formula 2. These formulae can only be used as interpolation formulae and are limited to the reduction of observations of wind.—*C. L. M.*

## DAILY MARCH OF WIND VELOCITY AT 30 M. ABOVE OSTEND AND 90 M. ABOVE BRUGGE.

By ALBERT PEPPLER.

[Abstracted from *Meteorologische Zeitschrift*, March–April, 1919, vol. 36, pp. 90–93.]

During the war measurements of wind velocity were made both at Ostend and at Brugge. The Ostend curve is a relatively simple one, showing a minimum at 3 a. m., a steady increase in speed to 3 p. m., and a quite steady fall again to the minimum. This period is especially marked on hot summer days. The Brugge curve is more complex. The principal minimum occurs at about 8 a. m., after which there is a steady increase to 1 p. m., followed by a fall to a secondary minimum at 8 p. m., and then a rise to the secondary maximum at 1 a. m. Thus, there are two 12-hour periods which combine to give wide variations in the daytime and secondary variations at night. It should also be noted that the higher anemometer gives speeds of smaller magnitude during the day and of greater magnitude during the night than the lower one.—*C. L. M.*

## THE DIURNAL VARIATION OF WIND VELOCITY IN THE FREE AIR.

By J. ROUCH.

[Abstracted from Comptes Rendus, Paris Acad. Aug. 11, 1919, pp. 293–295.]

In the upper layers of the atmosphere, different diurnal variations of wind velocity are observed from those in the lower layers. The speed is a maximum during the night and a minimum during the day. This has been observed by Angot on the Eiffel Tower and is substantiated by numerous mountain stations.

Certain pilot balloon observations made during the summer of 1918 have been grouped by time of day and the mean differences between the two times taken for a given level. These were grouped for morning and afternoon. In Table 1 the plus sign (+) denotes an afternoon wind greater than a morning wind; the minus sign (−) indicates an afternoon wind less than the morning wind.

This table shows that the wind speed in the morning is greater than the afternoon wind at 200 meters at Bayonne, Cette, and Rochefort; between 200 and 400 meters at Havre; between 400 and 600 meters at Oran; and, as has been mentioned, at Paris, at an altitude of 300 meters, it is a maximum during the night and a minimum during the day. This difference is noted to an altitude of 2,000 meters, although it is a maximum at about 1,000 meters. Above 2,000 meters it appears that the time of day does not make much difference, although there is a slight indication that the winds of afternoon above that level are greater than those of the morning. Above the 3,000-meter level observations are insufficient for drawing conclusions; below, it is believed that the above-stated relations are valid.—*C. L. M.*

TABLE I.

| Stations. | Times. | Altitudes (meters). | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 200 | 400 | 600 | 800 | 1,000 | 1,500 | 2,000 | 2,500 | 3,000 | 3,500 | 4,000 |
| Oran (58)[1] | 7 a. m.–4 p. m. | +4.7 | +2.7 | +0.4 | −0.9 | −1.7 | −1.4 | −0.4 | −0.2 | +0.4 | +1.8 | ........ | ........ |
| Bayonne (44) | 7 a. m.–1 p. m. | +3.7 | −0.4 | −2.3 | −2.1 | −0.9 | −0.4 | −0.3 | −1.1 | −0.9 | −0.1 | ........ | ........ |
| Cette (69) | 7 a. m.–1 p. m. | +1.2 | −0.8 | −2.2 | −1.6 | −1.5 | −1.7 | −1.3 | ........ | ........ | ........ | ........ | ........ |
| LeHavre (21) | 7 a. m.–1 p. m. | +2.5 | +0.5 | −1.8 | −2.0 | −1.5 | −1.0 | −1.2 | ........ | ........ | ........ | ........ | ........ |
| Rochefort (36) | 7 a. m.–12 m. | +1.5 | −4.6 | −3.6 | −3.2 | −2.1 | −0.8 | −0.7 | −0.8 | −0.2 | 0.0 | ........ | ........ |
| Saint-Cyr (40) | 7 a. m.–2 p. m. | +1.7 | ........ | ........ | ........ | ........ | −0.8 | ........ | +0.6 | ........ | +0.5 | ........ | +0.3 |

[1] Numbers in parentheses indicate number of observations.

## THE INFLUENCE OF THE VELOCITY OF THE WIND ON THE VERTICAL DISTRIBUTION AND THE VARIATIONS OF THE METEOROLOGICAL ELEMENTS IN THE LOWER LAYERS OF THE ATMOSPHERE.

By C. E. BRAZIER.

[Comptes Rendus, Paris Acad. Sci. January 20, 1919, pp. 179–182.]

The barometric pressure at the ground level, calculated from observations made on the Eiffel Tower, is lower than the observed pressure. When the mean wind for 24 hours is 0.9 meters per second on the ground, and 4.4 meters per second at the top of the tower, and the surface pressure was 761.4 mm. and the tower pressure was 736.5 mm., the computed ground pressure was 761.3 mm., thus showing a difference of 0.1 mm. In the case of a moderate wind (mean velocity, base 2.1, top 8.1 m/s) this difference is 0.2 mm., and in the case of a strong wind (mean velocity, base 3.7, top 11.5 m/s) it increases to 0.3 mm., showing clearly that the difference increases with the speed of the wind.

The discussion is closed with the following three conclusions relative to other meteorological relations: "1st. For a given diurnal variation of the amount of heat received by the earth from the sun, the amount of the diurnal variation of air temperature in the immediate neighborhood of the ground, is greater for a gentle wind than for a strong one.

"2d. Except at a certain level, the altitude of which may vary with the season and the place of observation and which, in April and above Paris, is lower than 200 meters, the amplitude of the daily variation of air temperature increases, other things being equal, with the speed of the wind.

"3d. It appears, therefore, that in our situation, it is possible to conclude that there is a certain layer of air situated at a relatively low altitude above the earth in which the diurnal variation of temperature is independent of the speed of the wind."—*C. L. M.*

## THE INFLUENCE OF THE VERTICAL DISTRIBUTION OF TEMPERATURES ON THE VELOCITY OF THE WIND NEAR THE SURFACE.

By C. E. BRAZIER.

[Abstracted from Comptes Rendus, Paris Acad., June 10, 1919, pp. 1160-1161.]

Having previously shown that the speed of the wind influences the vertical distribution and diurnal variation of the meteorological elements in the lower layers of the atmosphere (see abstract above), the author now finds that a comparative study of the gradient and of the speed of the wind near the surface (over the continents) demonstrates that the diurnal variation in the speed of the wind can not be explained by any diurnal change of the gradient, but only by an exchange between the surface and higher layers, the intensity and extent of which would depend upon the vertical temperature distribution. Utilizing observations at the Central Office (elevation 21 meters) and the Eiffel Tower (elevation 305 meters), and obtaining the gradients from the daily maps, he investigates the effect of vertical temperature changes upon the winds given by the gradients. Preliminary results indicate that at the Central Office whatever the direction and value of the gradient, the measured wind speed is on the average, less, for that given gradient, when there is an inversion of temperature, than when the contrary is true; the speed increases progressively as the decrease of temperature upward becomes more marked in the lower 300 meters. At the summit of the Tower, however, the speed, for a given gradient, becomes a maximum when the temperature at that level approaches the simultaneously existing temperature at the Central Office. These results are not due to the greater frequence of inversions during light winds.

The results indicate that the ratio of wind velocity to gradient at the height at which anemometers are placed is too greatly influenced by the vertical temperature distribution for the latter to be neglected in the experimental determination of the law connecting the two quantities.—*E. W. W.*

## ON THE RELATION OF WIND TO THE GRADIENT IN THE LOWER LAYERS OF THE ATMOSPHERE.

By C. E. BRAZIER.

[Abstracted from Comptes Rendus, Paris Acad., Oct. 27, 1919, pp. 730-733.]

In the paper abstracted just above the author showed that the speed of the wind in the lower layers of the atmosphere was not only dependent upon the gradient, but also upon the vertical distribution of temperature. In this paper he discusses the angle made by the wind direction and the gradient, which is dependent upon the pressure distribution and also upon the vertical distribution of temperature. First, with a constant pressure gradient, he finds that the angle between the wind and the gradient at the surface is less when there is an inversion of temperature. With the temperature gradient constant, and the pressure gradient increased, the wind at the surface blows more nearly along the isobars. At the top of Eiffel Tower, with a constant pressure gradient, the effect of the inversion is much less marked, and what change there is appears to be in the opposite direction, i. e., toward parallelism with the isobars. In treating the angle between the wind at the top of the tower and that at the surface, use is made of the study of Angot, who found a diurnal variation in this difference; and this diurnal variation can be considered the result of the variations in the vertical distribution of temperature. The study of the concomitant variations of the temperature and of the speed of the wind in the first 300 meters leads to a conclusion that the total variation in the vertical distribution of temperature near the ground affects a layer of air relatively thin, but that its effect is felt to an elevation greater than that at which the gradient wind is usually found.—*C. L. M.*